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DEPARTMENT OF TRADE
AND INDUSTRY

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the documents annexed hereto are true copies of:

Application forms P.1 and P.2, provisional specification and drawings of South African Patent Application No. 2001/5462 as originally filed in the Republic of South Africa on 3 July 2001 and post-dated to 3 January 2002 in the name of NXCO INTERNATIONAL LIMITED for an invention entitled: " EXPOLOSIVE SHOCKWAVE CONCENTRATOR ".

Geteken te
Signed at PRETORIA in die Republiek van Suid-Afrika, hierdie
in the Republic of South Africa, this 15th dag van
day of May 2003

Registrateur van Patente
Registrar of Patents

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FORM P2
M R & F Ref: P.19156/Case 6

REPUBLIC OF SOUTH AFRICA	REGISTRAR OF PATENTS	PATENTS ACT, 1978

Post-dated

Official Application No.			Lodging date: Provisional		Acceptance date:	
21	01	20015462	22	3 ~~JULY 2001~~ 3.1.2002	47	
International classification			Lodging date: Complete		Granted date:	
51			23			

Full name(s) of applicant(s)/Patentee(s)	
71	NXCO INTERNATIONAL LIMITED

Applicant(s) substituted:		Date Registered:
71		

Assignee(s):		Date Registered:
71		

Full name(s) of inventor(s)	
72	To be advised

Priority claimed	Country		Number		Date	
Note:	33	NONE	31	NONE	32	NONE
Use International	33		31		32	
Abbreviation for Country	33		31		32	

Title of Invention:	
54	EXPLOSIVE SHOCKWAVE CONCENTRATOR

Address of applicant(s)/patentee(s)

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Patent of Addition No.		Date of any change:	
61			
Fresh Application based on:		Date of any change:	

McCALLUM, RADEMEYER & FREIMOND
- Ref: P19156/Case 6

FORM P1
6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1) - Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
R10 R50
2001-07-03
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

OFFICIAL APPLICATION NO.

21	01	20015462

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

ADDRESS(ES) OF APPLICANT(S)

Saffrey Square, Suite 205, Bank Lane, Nassau, Bahamas

TITLE OF INVENTION

54	EXPLOSIVE SHOCKWAVE CONCENTRATOR

Priority is claimed as set out on the accompanying Form P2.
The earliest priority claimed is :

This application is a patent of addition to Patent Application No.	21	01	
This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

X	1	A single copy of a provisional specification of 8 pages
	2	Two copies of a complete specification of .... pages
X	3	.2 . sheets of Informal Drawings
	4	.... sheets of Formal Drawings
	5	Publication particulars and abstract (Form P8 in duplicate)
	6	A copy of Figure .... of drawings (if any) for the abstract
	7	Assignment of Invention
	8	Certified priority document(s) Number(s)
	9	Translation of priority document(s)
	10	An assignment of priority rights
	11	A copy of the Form P2 and the specification of SA Patent Application No. 21 01
	12	A declaration and power of attorney on Form P3
	13	Request for ante-dating on Form P4
	14	Request for classification on Form P9
X	15	Form P2 in duplicate

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Dated this 3rd day of July 2001.

....
McCALLUM, RADEMEYER & FREIMOND

REGISTRAR OF THE COURT OF THE COMMISSIONER OF PATENTS
Registrar's Official Date Stamp
3.1.2002
~~2001-07-03~~ Post dated
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McCALLUM, RADEMEYER & FREIMOND
P.19156/Case 6

FORM P6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) - Regulation 27)

OFFICIAL APPLICATION NO

LODGING DATE Post-dated

21	01	20015462		22	3.1.2002 3 ~~JULY 2001~~

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

FULL NAME(S) OF INVENTOR(S)

72	To be advised

TITLE OF INVENTION

54	EXPLOSIVE SHOCKWAVE CONCENTRATOR

BACKGROUND OF THE INVENTION

This invention is concerned generally with a customized low energy method of breaking rock in a controlled manner.

As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above or underground which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

A number of techniques have been developed for the breaking of rock using non-explosive means. These include a carbon dioxide gas pressurisation method (referred to as the Cardox method), the use of gas injectors (the Sunburst technique), hydrofracturing and various methods by which cartridges containing energetic substances pressurise the walls or base of a sealed drill hole to produce penetrating cone fractures (known as PCF).

These techniques may be an order of magnitude more efficient than conventional blasting in that they require approximately 1/10 of the energy to break a given amount of rock compared to conventional blasting using high explosives. The lower energy reduces the resulting quantity of fly rock and air blast and to an extent allows the rockbreaking operation to proceed on a continuous basis as opposed to the batch-type situation, which prevails with conventional blasting.

Low energy rockbreaking methods, such as those using propellants, generally use high gas pressures to propagate fractures originating from microfractures

and points of weakness in the rock such as joints and faults. Depending on rock conditions and mining requirements such as breaking rock to a particular size, it may be desirable to induce a region of high stress concentration at any chosen location, at the bottom or otherwise, in the drill hole, to initiate new fractures in the rock. An object of the present invention is to achieve such a result.

SUMMARY OF INVENTION

The invention provides a method of breaking rock which includes the steps of:

(a) loading a cartridge into a hole in a rock face;

(b) initiating a propellant in the cartridge thereby to generate a shock wave inside the hole; and

(c) detonating a high-explosive inside the hole to generate a localised explosive shock wave in the rock.

Step (b) may be carried out, according to requirement, substantially simultaneously with step (c) or slightly before or slightly after step (c).

In step (c) more than one high-explosive may be detonated. These high-explosives may be detonated substantially simultaneously or a second high-explosive may be detonated a predetermined time period after detonation of a first high explosive.

The method may include the step of deforming the shock wave which is produced by the propellant. The shock wave may be deformed in a region

which is close to or substantially coincident with the region in which the high explosive is detonated in step (c).

The invention also provides apparatus for breaking rock which includes a cartridge, a propellant inside the cartridge, and at least one high-explosive charge on or inside the cartridge.

The apparatus may include at least one shock wave deforming member. The deforming member may be positioned inside or outside the cartridge and may be positioned at a region which is adjacent the location at which the said high-explosive charge is located.

The cartridge is preferably made from a plastically deformable material. Thus the cartridge may be made from a material which is capable of plastic deformation, without rupturing, by at least a predetermined extent.

As used herein " propellant" is to be interpreted broadly to include a blasting agent, a propellant, gas-evolving substance or similar means which, once initiated, generates high pressure material typically at least partly in gaseous form. "Blasting agent" and "propellant" are used interchangeably in this specification.

"Propellant" is to be distinguished from an "explosive" or "high-explosive". Each of the latter terms, which are used interchangeably herein, means an energetic substance which gives rise to an explosive shock wave which

results from a more rapid detonation or combustion of the energetic substance, than that which occurs with the propellant.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of examples with reference to the accompanying drawings Figures 1, 2 and 3 which respective illustrate different forms of apparatus for breaking rock according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 of the accompanying drawing illustrates a hole 10 which is drilled in a rock mass 12 from a face 14 using conventional drilling equipment, not shown.

A cartridge 16 is loaded into the hole 10. The cartridge has a base 18 and a generally cylindrical wall 20 which extends from the base and which at an upper end has a rounded or dome-shaped closure 22.

The cartridge houses a propellant material 24 which is of known composition. The propellant is loaded into the cartridge under factory conditions using techniques which are known in the art. An initiator 26 is loaded into the cartridge. In this example the initiator is located at the upper end 22 but this is by no means limiting and the initiator can be engaged with the cartridge at any appropriate point.

Control wires 28 lead from the initiator to a unit, not shown, which is used in a known manner for initiating the rock-breaking process.

Stemming 30 is placed into the hole 10 from the rock face 14 covering the cartridge to a desired extent. The stemming is tamped or otherwise consolidated in position. The nature of the stemming and its manner of use are known in the art and for this reason are not further described herein.

The cartridge has a diameter which is slightly less than the nominal diameter of the hole. Thus it is possible to place the cartridge into the hole without the cartridge becoming frictionally jammed against the wall 30 of the hole. It is desirable for the base 18 to fit closely against the bottom 32 of the hole.

Two rings 40 and 42 of high-explosive material are positioned inside the cartridge at desired locations and are secured in position using any appropriate technique. In the illustrated example the ring 42 rests on the base 18 of the cartridge while the ring 40 is adhesively secured to the inner surface of the wall 20. The nature of the high-explosive material may vary according to requirement and for example may comprise CORTEX or P10 (these are registered trade marks) or the like. The high-explosive material may also comprise or include aluminium powder or any other high energy content material.

When the propellant 24 is ignited a shock wave propagates through the cartridge interior as combustion of the propellant takes place. High pressure material is released by the combusted propellant. The high-explosive rings 40

and 42 are also detonated at precisely controlled times. When the high-explosive ring 40 is detonated an explosive shock wave is generated which reinforces the propellant shock wave. Another effect which comes into play is that the explosive shock wave can increase the efficiency of combustion of the propellant and in this way enhance the propellant shock wave. It is believed that the explosive shock wave can act as a booster to the propellant shock wave and thereby increase the intensity of the shockwave on the rock. In essence therefore respective or separate shock waves are generated by each high-explosive ring and the propellant. Particularly in the regions of the high-explosive rings 40 and 42 high energy stress regions are created in the adjacent rock masses.

The cartridge 16 initially expands plastically confining the high pressure material which is released by the combustion and explosive processes. Substantial force is thereby generated inside the cartridge. As the cartridge fractures the energy released by the explosive rings 40 and 42 combined with the energy contained in the shock wave from the propellant 24 results in localised fracture of the rock at least initially in the region of the ring 40 and at the bottom of the hole.

In the example of the invention shown in Figure 2 components which are the same as those described in connection with Figure 1 bear like reference numerals and are not further described herein.

In the Figure 2 embodiment an explosive ring 44 is positioned on an external surface of the cartridge 16. The explosive ring is detonated at a carefully chosen time relatively to the instant at which the propellant 24 is ignited. Once again the shock wave produce by the propellant is enhanced or boosted by the shock wave generated by the detonation of the explosive 44.

Figure 2 illustrates a further variation in that alternatively or in addition to the ring 44 an explosive charge 46 may be positioned inside the propellant 24. In the first instance the charge 46 acts to deform the shock wave which is produced by the propellant 24 while a second effect arises, in a manner similar to what has been described, once the explosive 46 is detonated in that a booster shock wave is generated which enhances the effect of the propellant shock wave.

Figure 3 illustrates an embodiment of the invention in which deformation of the propellant shock wave is achieved by means of a ring or any other appropriate deforming member 50 which, in this example, is positioned inside the cartridge 16. An inwardly extending peripheral groove 52 is formed in the side wall 20 of the cartridge and the ring 50 rests on the groove. The groove is externally filled with explosives 54 which is sealed in position by means of a surrounding cover strip 56. When the propellant 24 is ignited the ring 54 acts to deform the resulting shock wave and this gives rise to a high energy region of the shock wave in the vicinity of the ring 50. The explosive 54, once detonated, produces an explosive shock wave which enhances the high

energy region and this promotes fracture of the rock body in the locality of the ring and the groove 52.

An important aspect of the invention resides in the ability of the cartridge to contain the propellant shock wave so that premature release of the energy generated by the propellant combustion does not take place. The shock wave which is caused by detonation of the explosive enhances the propellant shock wave and once the cartridge fractures the rock mass is caused to fracture by the release of high pressure jet material directed at the rock at a controlled region which is determined beforehand.

In the various examples the explosive charges can be detonated by means of control signals transmitted over wires 28A which are connected directly to the wires 28.

It is possible though to connect the wires 28A to a separate control unit so that, in each case, the respective initiator 26 is initiated at a first time while the respective explosive is detonated at a second time which may be a predetermined period before or after the first time.

Dated this 3rd day of July 2001.

McCALLUM, RADEMEYER & FREIMOND
Patent Agents for the Applicant

FIG 2

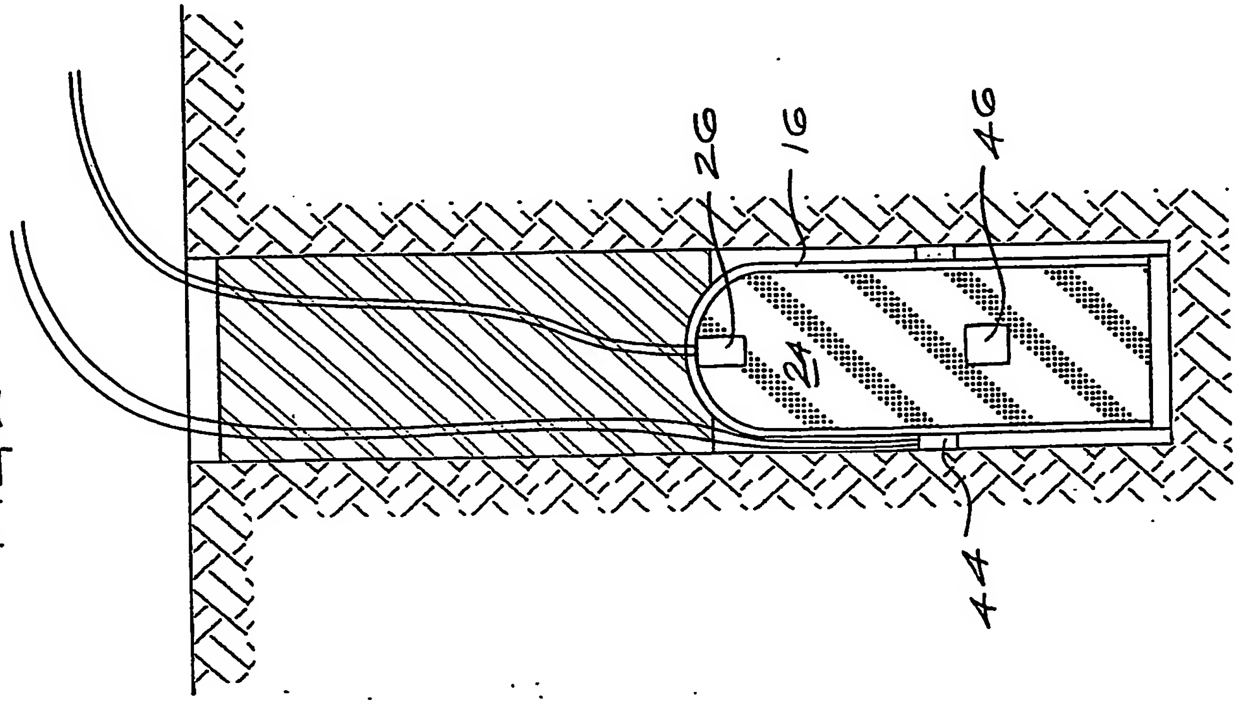

FIG 1

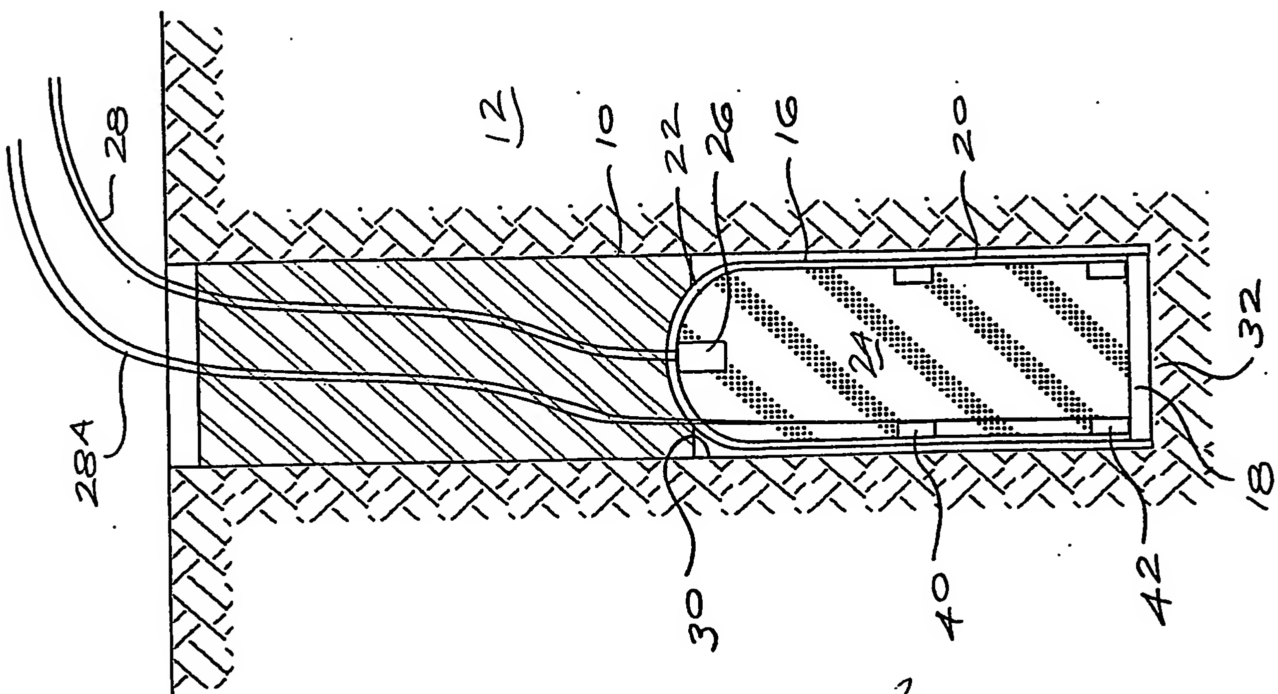

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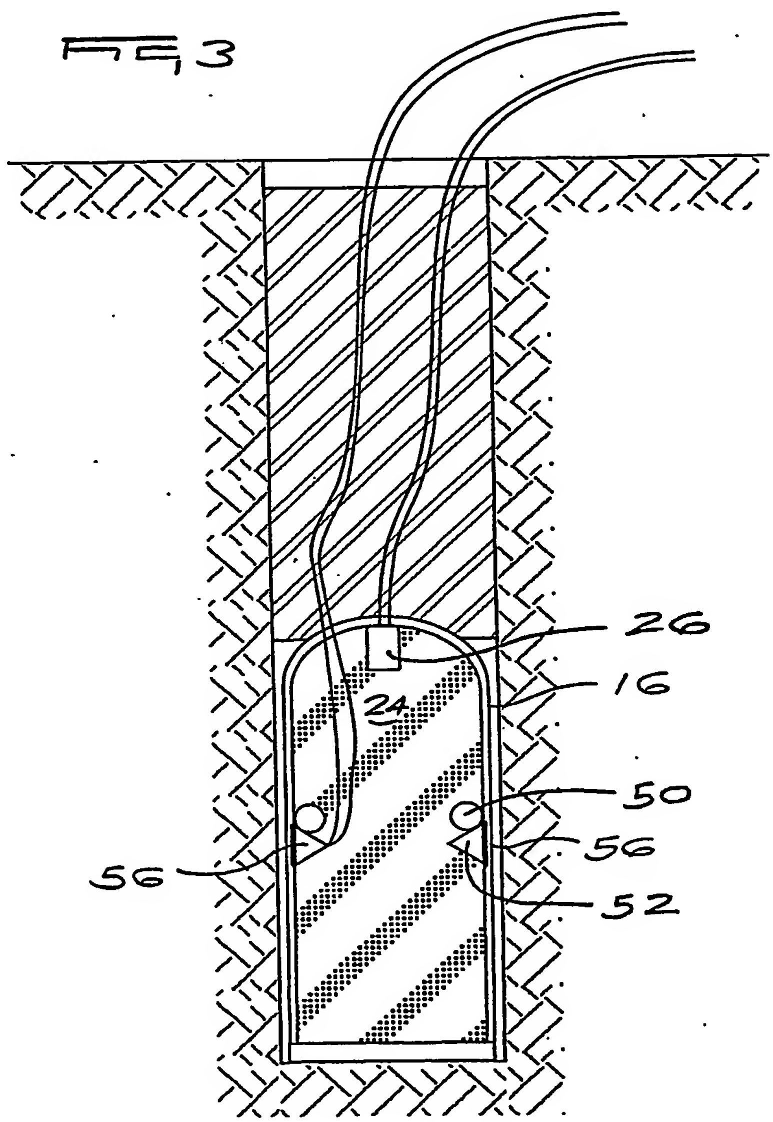
FIG 3



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